Redfish

July, 2012 (Issue #13)

Red Sea Clownfish
1st Anniversary Special

Reef

Reefkeeping Journal - Part III

BLOG

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Tropical

Angelfishfish - not always angels!

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About Redfish

Redfish is a free-to-read magazine for fishkeeping enthusiasts.

At Redfish we believe in the free exchange of information to facilitate success by aquarium and pond hobbyists. Each month Redfish Magazine will bring you dedicated sections on tropical, coldwater, marine and ponds.

Redfish was founded in early 2011 by Jessica Drake, Nicole Sawyer, Julian Corlet and David Midgley.

We hope you enjoy this, the 13th issue of Redfish.

古池や蛙飛込む水の音
ふるいけやかわずとびこむみずのおと

Photo courtesy: (matt)

The Fine Print
Redfish Magazine

General Advice Warning

The advice contained in this publication is general in nature and has been prepared without understanding your personal situation, experience, setup, livestock and/or environmental conditions.

This general advice is not a substitute for, or equivalent of, advice from a professional aquarist, aquarium retailer or veterinarian.

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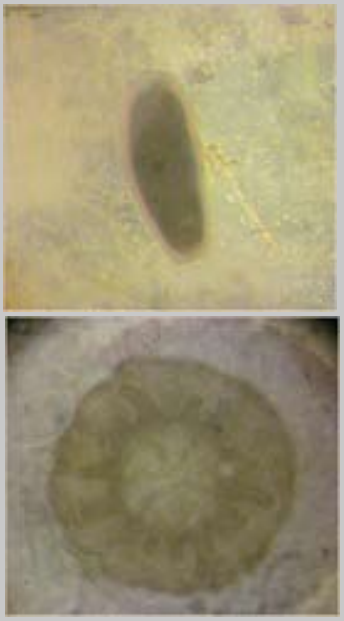
Protomelas spilonotus - Photo Brian Gratwicke

Genetic "Gift" from Bacteria Could Be Helping Coral Reefs

by Hayley Rutger



Swimming coral larvae (above) must settle (below) to grow into adult corals. New research by Mote Marine Laboratory and collaborators has shown that these "baby" corals are more likely to settle with help from bacteria that share good genes. (Photo credit: Koty Sharp/ Eckerd College)

Coral reefs might be getting a major boost from bacteria that share good genes, report researchers who have found the first evidence that genetic packets from these bacteria help pave the way for "baby" corals to grow.

This ongoing study, being presented at an international coral conference, is a key advance in understanding the processes underlying coral reef growth and health. Reefs depend on intricate relationships between corals and many marine microscopic life forms, including the symbiotic algae within coral tissues and beneficial bacteria living on and near the reef. Most of these relationships are still being described by researchers.

"Coral reefs around the globe are under threat from climate change, ocean acidification and disease; to help reefs, we need to know much, much more about their basic biology, ecology and relationships with other forms of marine life," said Dr. Kim Ritchie, co-leader of the study and Manager of the Marine Microbiology program at Mote Marine Laboratory in Sarasota, Fla. "All of these things are vital for understanding how corals survive, grow and reproduce."

Swimming coral larvae (above) must settle (below) to grow into adult corals. New research by Mote Marine Laboratory and collaborators has shown that these "baby" corals are more likely to settle with help from bacteria that share good genes.

The current study is a team effort by Mote, the University of South Florida's College of Marine Science and King Abdullah University of Science and Technology (KAUST) in Saudi Arabia. Preliminary results were presented during the 12th International Coral Reef Symposium in Cairns, Australia (ICRS), which included participants from about 80 countries and is held every four years to advance scientific knowledge, conservation and management of coral reefs.

Scientists have long known that bacteria — most of which reproduce by splitting rather than sex — are also able to transfer genes from one to another through something called "horizontal gene transfer." One way bacteria do this is by producing particles called "gene transfer agents" (GTAs). In this process, random pieces of a donor bacterium's DNA are packed into GTAs — packets containing pieces of DNA called genes — and released. Once set free, like genetic escape pods, these GTAs act like viruses "infecting" other bacteria and spreading the donor's DNA fragments throughout the microbial community.

Researchers suspect that sharing GTAs could allow bacteria to spread beneficial genes across reefs, possibly helping corals, their resident algae or fellow reef-dwelling bacteria adapt to environmental challenges quickly. Sharing GTAs can take minutes, whereas adapting by traditional evolution can take thousands of years.

Research led by USF and Mote, published in a 2010 issue of Science, showed that widespread marine bacteria called Ruegeria transfer genes to other bacteria at remarkable rates on coral reefs.

In 2011, the researchers set out to test the effects of GTAs on coral offspring, or larvae, in the lab. Working at Mote's Tropical Research Laboratory on Summerland Key, Fla., the researchers investigated whether GTAs from bacteria called Ruegeria helped larvae of mustard hill coral (*Porites astreoides*) and mountainous star coral (*Montastraea faveolata*) settle to start growing. The larvae were placed in petri dishes with "biofilms" — clusters of microbes that are believed to help larvae attach to surfaces — and both the larvae and biofilms were treated with GTAs.

"When we added GTAs, the coral larvae were four times more likely to settle, which is a very exciting result," said Ritchie. With GTAs present, about 12 percent of coral larvae settled, compared with only 3 percent without GTAs. Project scientists from Mote and USF have continually replicated these results and this portion of their study is expected to be released this year.

Meanwhile, project scientists at KAUST are working to describe the gene-sharing process in detail. Ruegeria DNA appears to have its strongest effect on the bacteria, algae or other microbes in the biofilm, helping them grow, multiply, produce substances or do other activities that help provide a better "landing pad" for the coral larvae or assist them in settling. KAUST scientists plan to decode the DNA shared by Ruegeria and create a detailed map showing which genes are "turned on" by the GTAs in the organisms receiving them.

"Corals and their associated microbes must be understood as a whole 'metaorganism'; marine microbes are central to coral reef ecology in ways that the research community is just beginning to discover," said Christian R. Voolstra, Assistant Professor of Marine Science at KAUST. "Advancing this frontier is important to us, and we are grateful to collaborate internationally with Mote and USF scientists who are breaking new ground in this important line of reef research."

"What we're learning in the lab could, in time, lead to a new understanding of coral reefs in the ocean," said Dr. John Paul, Distinguished University Professor of Biological Oceanography at USF. "Reefs around the world host a number of bacteria that produce GTAs. By learning what these gene-swapping bacteria might contribute to coral life cycles, we can provide resource managers essential knowledge to protect or even enhance reefs."

This project was funded by the National Science Foundation, the Dart Foundation, the Moore Foundation, KAUST and the Protect Our Reefs grants program, which receives its funds from sales of the Protect Our Reefs specialty license plate administered by Mote and available to Florida drivers. Protect Our Reefs provides crucial support to groundbreaking reef research focused on corals in the Florida Keys, home to the only barrier reef in the continental U.S. Learn more and learn how Florida drivers can purchase the plate at www.mote.org/4reef.

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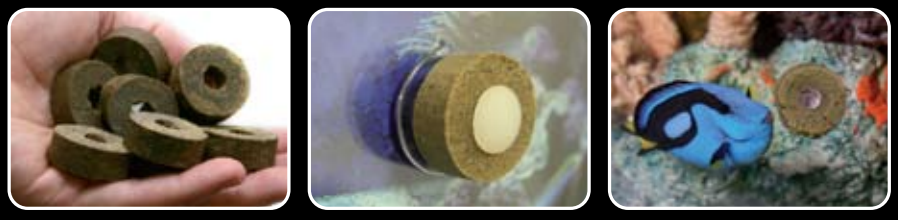

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Raul's Reef

150 gallon - Garden Eel - Mixed Reef

by Raul Roman. Photos by Raul Roman & Melissa Tolbert Cook

Soon to celebrate its 2-year anniversary, my 150 gallon mixed reef actually has some live rock, live sand and mushroom corals that have been in my care for 9 years. What started out as a 29 gallon reef aquarium has now progressed into what I hope to showcase in this article. The aquarium itself is a Marineland Deep Dimensions glass cube. It is 36 inches (91.4 cm) squared and 27 inches (68.6 cm) tall. It features a single corner overflow, black silicone corners and 1/2 inch (1.3 cm) thick glass. The tank adorns a corner of my home's living room sitting on its 32 inch (81.3 cm) high all-wood stand. This height is a nice compromise that shows well from a sitting or standing position.

There are several competing themes in the aquarium's composition but the overwhelming theme is that of a large and deep sandy area housing 8 garden eels. Garden eels live inside dug burrows from which they extend out to capture food that floats with the current. The don't extend completely out of their burrow except to relocate and this is something that occurs fairly infrequently once they settle into their captive homes. A giant clam that is approximately 14 inches (35.6 cm) in length also competes for the attention of observers. A Long Tentacle anemone extends out about 12 inches (30.5 cm) hosting a single Tomato clownfish. The rest of the aquascaping consist of about 100 lbs. (45.4 kg) of live rock encrusted with mushroom corals and various varieties of encrusting soft and hard corals. Extending vertically from the rock formation are various branching soft corals and gorgonians.

the overwhelming theme is an open sandy area that houses 8 garden eels. Fringing this area is low reef featuring various inverts. Photos by Melissa Tolbert Cook.

Clean and chemically appropriate saltwater at an optimal temperature is what we as reef caretakers should always strive to provide our aquarium life. I employ protein skimming, carbon media and beneficial bacterial cultures to help rid the aquarium of dissolved waste matter. The recent advances in the use of probiotics to help control algae-promoting phosphates and nitrates have really made the appropriate feeding of our fish and corals a much easier task. Thriving captive reefs that are well fed have replaced the anemic conditions we used to be forced to maintain in order to keep nuisance algae at bay.

Finally our precious livestock also depend on good water flow and intense lighting just as typically observed in our natural wild reefs. To accomplish this I use a Vortech propeller pump to provide a gyre flow pattern inside my glass box. Lighting is provided via 400 watts of intense metal halide lighting with T5 high output florescent lighting to help round out the light spectrum to provide an eye-pleasing array of colors and biofluorescence.

I'm a big fan of bulleted lists so I will elaborate on the equipment, husbandry and livestock in this format with picture accompaniment to bring it all into focus. This aquarium is much more than my hobby and I am excited to share it with the Redfish readership and I humbly hope you will enjoy flipping through the next few pages. I welcome all comments, questions and suggestions and you may send those to raulroman@cox.net.

Life Support and Water Filtration Equipment

Lighting

400 watt single-ended Metal Halide retro fixture

- Radium 20K bulb
- Hamilton magnetic HQI ballast with built-in enclosure
- Spider-type aluminum polished reflector
- Light period is from 11:30 am to 8:15 pm controlled by AC3 Controller

Wavepoint 156 watt 4-bulb T5 High Output fixture

- 2 Actinic bulbs (Wavepoint Reef Wave)
- 1 Blue bulb (Wavepoint Blue Wave)
- 1 Red/Actinic bulb (Wavepoint Coral Wave)
- Light period is from 10:45 am to 9:00 pm controlled by AC3 Controller

one of the features of the aquarium is a Long Tentacled Anemone (*Macrodactyla doreensis*) that hosts a Tomato Clownfish (*Amphiprion frenatus*) Photos by Melissa Tolbert Cook.

Two Garden Eels, *Heteroconger hassi* & *Gorgasia preclara* poke their heads out of their homes. Photo by Raul Roman.

the mottled mantle of this Giant Clam - which is 35cm (14") across - is a feature in the aquarium. Photo by Melissa Tolbert Cook.

Water Monitoring and Equipment Control

Neptune Systems Aquacontroller 3

- pH monitoring and control
- ORP monitoring and control
- Temperature monitoring and control
- Programmable timers, sensors and alarms
- Freshwater top-off automation
- Water on floor leak detector monitoring
- Water high/low float switch monitoring
- iPhone/iPad Monitoring/control App
- All controller functions accessible through the Internet
- Email alarms and status updates
- Battery backup allows email alarm to be sent during power outage and also notify when power is restored.

Water Circulation

Ecotech Vortech MP10 propeller pump

- Adjustable from 750 to 5500 litres (200 to 1,500 gallons) per hour of flow
- Vortech Automatic Battery backup capable of running for 72 hours
- Long Pulse Mode @ 100% speed w/ 25s interval

Sicce Syncra 3.0 return pump

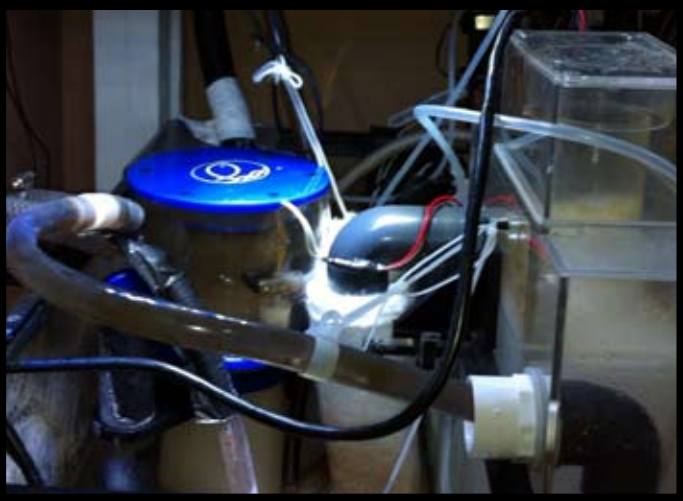
- Around 2200 litres (600 gallons) per hour.
- Water returned from sump via a lockline nozzle.
- Vortech and Syncra pumps are used to create a gyre-style of flow pattern inside the aquarium.

Filtration

- 120 litre (30 gallon) glass tank sump
- Eshopps S-150 Cone Protein Skimmer (in sump style)
- Reef Octopus BH-800S Hang-on-back Protein Skimmer (fed with 100% bio-pellet treated water)
- Kent Marine Phos Media Reactor with Brightwell Katalyst Bio Pellets and Dr. Tim's NP-Active Pearls (2 cups total)
- 1 cup of Bulk Reef Supply Rox 0.8 Activated Carbon in media bag placed in sump water polishing filter sock.

a Kent Marine Phos Media Reactor hangs on the side of the sump running Bio Pellets.
Photo by Raul Roman

a Neptune Systems Aquacontroller 3 (AC3) monitors the system via various sensors. It is connected to an iPad or iPhone where there's an interface for control/monitoring of the system via the internet.
Photo by Raul Roman



The Eshopps S-150 (blue lid) and Reef Octopus (perspex, right) sit side-by-side in the sump. The latter is fed with water exiting the Bio Pellets.
Photo by Raul Roman

Foam being fractionated by the Reef Octopus.
Photo by Raul Roman

Temperature Control

- 300 & 50 watt glass heaters controlled by stand-alone electronic thermostat.
- JBJ Mini Arctica 1/15 HP water chiller controlled by AC3 controller.
- Water maintained between 25.5 - 27.2° C (78-81°F) degrees in the summer and 24.4 - 26.1° C (76-79°F) degrees in the winter.

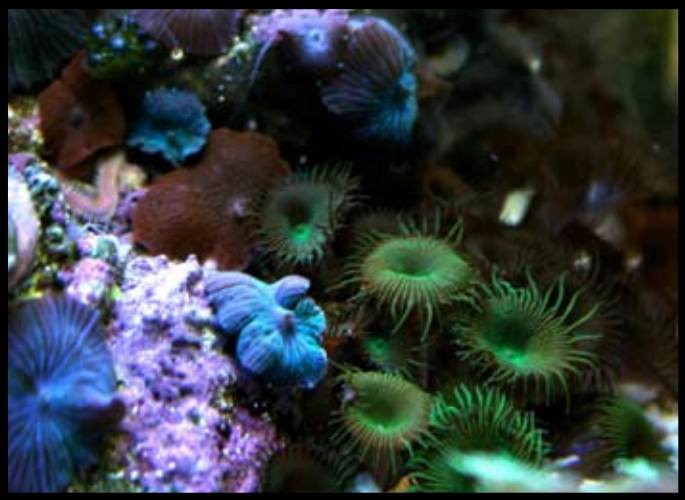
Misc. Equipment

- Two Aquahouse dosing pumps programmed to dispense 1 3.79 litres (1 gallon) of a balanced 2-part buffer and calcium mixture.
- Eshopps Square Filter Sock assembly.
- Eheim Feed Air Automatic Fish Food dispenser.
- UPS backs up AC3 controller and Bio-pellet reactor
- 14 gallon freshwater reservoir mixed with 6 tablespoons of Kalkwasser powder.
- Skimmers are fed with outside air via a hole in the wall.
- APC Power Strips all plugged into a GFI circuit.
- 8-outlet power strips with On/Off switches used for manual equipment power control.
- Foscam Netcam for streaming live video of tank. Stream accessible from the Internet.

Livestock

Sessile Inverts

- *Eunicea mammosa*, Swollen-Knob Candelabrum
- *Euphyllia paranchora*, Branching Hammer Coral
- *Actinodiscus* sp, Mushroom Coral
- *Ricordea florida*, Ricordia Mushroom Coral
- *Ricordea yuma*, Yuma Mushroom
- *Zoanthus* sp, Zoanthid Polyp Coral
- *Sinularia* spp, Tree/Finger Leather Coral
- *Blastomussa wellsi*, Blastomussa Coral
- *Caulastrea curvata*, Trumpet Coral
- *Favites* spp, Favites Brain Coral
- *Blastomussa merletti*, Aussie Blastomussa Coral
- *Goniastrea palauensis*, Goniastrea Brain Coral
- *Acanthastrea lordhowensis*, Acan Lord Coral
- *Echinophyllia aspera*, Aussie Chalice Coral
- *Montipora undata*, Encrusting Montipora Coral
- *Protopalythoa* sp, Paly Button Polyp Coral
- *Dendrophyllia fistula*, Dendro Sun Coral
- *Platygyra* sp, Brain/Worm Coral
- *Xenia* sp, Pulsing Xenia
- *Diodogorgia nodulifera*, Yellow Polyp Gorgonia



Some of the residents of Raul's Reef, including a Tube Anemone (Top), Various mushrooms (*Acintodiscus*) and the green polyps of a *Protopalythoa* (Middle) and *Ricordea* species (Bottom). Photos by Melissa Tolbert Cook.

ABOUT THE AUTHOR

Raul Roman

Raul Roman BSc. has over 20 yrs. experience in the saltwater aquarium hobby ranging from hobbyist to owner and operator of a coral propagation business. Raul's current involvement in the hobby is as an article contributor to some of the aquarium hobby's finest publications, as the president of the Marion Ocala Reef Enthusiasts fish club, and the caretaker of his 150 gallon garden eel dominated reef aquarium. Raul can be reached at raulroman@me.com for comments or questions.

- *Diodogorgia nodulifera*, Yellow Finger Gorgonia
- *Scolymia australis*, Australian Scoly

Fish
- *Nemateleotris magnifica*, Common Firefish
- *Neocirrhitus armatus*, Flame Hawkfish
- *Oxy. longirostris*, Orange Spotted Filefish
- *Taenioconger hassi*, Spotted Garden Eel
- *Gorgasia preclara*, Splendid Garden Eel
- *Chromis retrofasciata*, Black Bar Chromis

Motile Inverts
- *Lysmata amboinensis*, Common Cleaner Shrimp
- *Lysmata wurdemanni*, Peppermint Shrimp

Husbandry

Daily:
- Observation of bio-pellet media to ensure appropriate tumbling action. Replenishing of bio-pellet media as needed.
- Feeding of frozen foods, pellet food and flake food. (several times throughout the day)
- Monitoring of ORP, pH and temperature.
- Checking for properly functioning filtration equipment and appropriate water flow.
- Observation of livestock health.

Weekly:
- Replacement of filter sock and carbon media.
- 14 gallons of Kalk water mixed for use as automatic water evaporation top-off.
- Cleaning of glass.
- Emptying, cleaning of protein skimmer collection cups.
- Checking liquid level in 2-part containers, replenishing as needed.

Monthly:
- 30% water changes.
- Test water to determine levels of calcium, alkalinity, phosphate and nitrate.
- Glass algae scraping

Every 6 months:
- Cleaning of pumps and other equipment preventative maintenance.
- Calibration of pH and ORP probes.
- Determine if lighting needs bulbs refreshed as all bulbs experience a negative shift in color spectrum and reduced intensity as they age.
- Check reverse osmosis water filtration equipment and for water output with sufficiently low dissolved organics. Replace RO as needed to maintain.

Bright green and purple zoanthids (Top), the unusual and beautiful Orange Spotted Filefish (Middle), Common Firefish swim over a host of Actinodiscus (Middle) and a green *Euphyllia paranchora* (Bottom). Photos by Melissa Tolbert Cook.

Angelfish

By Lea Maddocks

When many people think of a large tropical freshwater fish tank, the feature fish often commonly envisioned is the angel. Angelfish are beloved by many aquarists, and they have been a long term staple in the hobby. Indeed, its distinctive shape often graces the packaging of many aquariums and aquarium items. This popularity is for good reason. Its elegant and distinctive shape are eye catching in any tank. Its personality is endearing, and its peaceful method of swanning about the tank is both regal and relaxing to watch. It is usually peaceful with fish not too small to be eaten and as such it often makes a good choice for community tanks (with the occasional exception). It is also generally a hardy fish, and this makes it a good choice for beginners with a medium to large sized aquarium. Finally, extensive breeding efforts have produced a wide variety of colour variations along with some variation in fin size. I recall the first time I saw a black lace veil-tail angelfish at my local club meeting, truly a jaw dropping sight.

Angels originate from South America in the still, highly vegetated waters of the Amazon, Ucayali, and Solimoes Rivers which cross the countries of Peru, Columbia, and Brazil. They have also been found in the Rio Oyapock in French Guinea, and Essequibo River in Guyana

History and species information

The common angelfish (*Pterophyllum scalare*) is a member of the cichlid family. Angels originate from South America in the still, highly vegetated waters of the Amazon, Ucayali, and Solimoes Rivers which cross the countries of Peru, Columbia, and Brazil. They have also been found in the Rio Oyapock in French Guinea, and Essequibo River in Guyana. Shoals are often large, and fish commonly swim amongst aquatic vegetation in slow moving sections of river, tributaries, flood plains and swamps and amongst rushes and other plants at the river edges. They are a predatory fish, their natural diet consisting of a mix of small aquatic insects, larvae, worms and crustaceans. They will also eat fry small enough to fit in their mouths. In the wild fish will favour long stemmed or large leaved plants to lay eggs on, and will show a degree of parental care common to many species of cichlids. However, as this parenting skill is not essential to survival of fry in a hobbyists breeding tank, most domesticated angels now lack this paternal care instinct.

The flooded forest in the Amazon, and its typical blackwater is home to the iconic freshwater Angelfish. Photo by Jorge Andrade

Colour variations

One of the first fish exported from South America, *P. scalare* rapidly became commonplace in stores internationally and actively bred by hobbyists for size, shape and colour. Original colourations can now be somewhat rare and hard to find, but are none-the-less striking. Wild colouration is a silver with a slightly brown tinge, with four thick black bars running vertically across the body, one running through the eye, two across the body, and one on the caudal fin. In a shoal in a planted or hard cape aquarium, this is a very impressive sight. From this beautiful but somewhat muted beginnings, other colour varieties now include zebra, with more stripes or white with many black stripes; silver; black; white; half black half white; black lace where a more mottled black colour on the fins displays a beautiful 'lace' like effect; golden; blushing, where gill covers or 'cheeks' display a reddish hue and the body is white; marble, which are a mottled pattern of black, white, silver, orange or gold; pearl scale, which possess similar scales to the pearl scale goldfish, where scales are rounded giving them a pearl-like appearance; veil-tail, where fish have highly elongated fins; koi, where fish have a body with splotches of orange, black, white or gold colours resembling a koi. Following these pure strains, angelfish which have been less carefully bred or cross-bred by hobbyists often appear in stores which display a mix of the above characteristics yielding a combination of colours and patterns, splotches and fin lengths, each of which is often unique and will ender buyers to a particular fish.

Tank size and set up

The purchase size for *P. scalare* is usually approximately 5cm/2in, though with a good varied diet these fish will grow to 10-15cm/6in in about a year, and up to 20cm/10in in height from the tip of the anal fin to the tip of the dorsal fin. Unfortunately, the small purchase size often leads unaware aquarists to keep these fish in small tanks. Given their large adult size, a bare minimum of 20gal/75L is essential for a single fish, with an additional 10gal/40L per additional angel. Additionally, a tank taller than 50cm/20in for angels is a must, given the long anal and dorsal fins, and the manner in which these fish swim. My own personal preference is to give these fish more space than the common recommendation, especially if a community tank is desired as additional room will provide for individual territories. I would

ABOUT THE AUTHOR

Lea Maddocks

Lea Maddocks has been a long-time fish enthusiast, SCUBA diving since age 15. A biologist (BSc, Hons, MPhil), Lea has a fascination with aquarium science including fish and invert husbandry, planted aquariums, reefs, and the art of aquascaping. Lea now operates Acumen Aquatics (www.acumenaquatics.com) providing aquarium installs, assistance, and maintenance; supplies her own FinSafe betta ornaments; is an active member of the Canberra District Aquarium Society, contributes to several fish and aquatic plant forums; and has written for the Australian RSPCA on the nitrogen cycle, goldfish and betta care. Lea owns three planted tanks, and routinely maintains many freshwater tanks, a turtle tank, a marine reef, and is a volunteer worker at the National Zoo & Aquarium in Canberra - in the aquarium section of course.

Altum Angelfish are a different species to the common Angelfish and are notably more difficult to keep and breed. Specialist cichlid keepers or specialty stores sometimes stock this unusual, but undenaibly beautiful, species.

Line breeding has resulted in numerous colour forms of the common Angelfish.

recommend a minimum 35gal/135L set up for a basic community with 1-2 angels and other select tank mates. An appropriate size for a group of angels of 4-6 would be a 55gal/200L aquarium. Though often peaceful, angels can be unpredictable like all cichlids and particularly aggressive and territorial when spawning, and this extra room will assist in minimising aggression between pairs, other lone individuals, or tank mates. The number of angels kept will heavily influence aggression (see Tank mates section below).

Another method of maximising success in an angelfish tank, whether a lone angel or a shoal, is to plant heavily and provide a large amount of cover. Not only will this break up lines of sight to other fish, but dense growth and plentiful hardscape will provide ample opportunities to form a well defined territory for the angels and other fish alike. It will also provide cover for those who feel threatened. Additionally, using large leaved plants such as Amazon swords, java fern, bobitus, anubias will also replicate their natural environments, and bring out the best in their look, swimming style and behaviour as they swan about the vegetation and even spawn on the long sloping leaves. Long stemmed plants such as hygrophillia, ludwigia, water wisteria, water sprite, ambulia, moneywort, hydrocotyle / Brazilian pennywort and valnesaria will create dense thickets in which to spawn and hide. These hardy plants are also relatively easy to grow and will benefit the aquarium health by absorbing waste nutrients and oxygenating the water during the day. Plus, combined with driftwood and aquarium safe rocks, will create a perfect natural looking backdrop to truly showcase your angelfish.

Maintaining stable temperatures and good mechanical and biological filtration are also essential, with chemical filtration being used as required. A quality heater and thermometer will ensure temperatures remain constant. Regarding filtration, a large wet/dry trickle filter or large hang-on-back (HOB) rated to the tanks size will suffice for smaller tanks (20-35g), though a quality canister filter with spray bar is optimal for larger aquariums. Given the preference of angelfish for still or slow moving water, and the fact that they do not do well in strong currents, I would recommend avoiding power heads. However, by using a spray bar attachment or other way to diffuse the flow, these can still work well. Turning down the flow is also an option, but it will reduce the filters efficiency by reducing the flow rate

through the tank.

Regarding lighting, any standard aquarium bulb will suffice in a hardscape or unplanted tank. However if you plan to use live plants, then using bulbs with a correct spectrum to encourage good growth is highly recommended, with a total light period of 8-10 hours to prevent algae. In addition, CO2 injection or liquid CO2 supplements and fertilizer supplements can also be useful to promote healthy growth and prevent algae. However, simply avoiding substrate siphoning around roots will allow mulm and detritus to collect, which will aid in fertilizing plants (and reduces cleaning time!).

Water Parameters

P. scalare are a hardy fish which, after many generations of captive breeding, are resilient to many aquarium diseases and are adaptable to a moderate range of water parameters. As long as water chemistry is kept stable, most will do well at temperatures between 24-30C, a pH range of 6-8, and very soft to moderately hard water from 1 - 13dH. However, angels will prefer water chemistry skewed towards that of their native Amazon waters, which are slightly acidic and soft. A stable temperature of 26-28C, pH of 6.5-7.0, and 3-10dH are advisable for long term health and successful breeding. Given their hardiness it is also likely to have a successful spawn in more alkaline, harder water given the parameters are stable and the temperature is raised to 28-30 C/80-86 F.

Feeding

Due to their long term raising in captivity, most *P. scalare* are unfussy and will take most commercial flake or pellet food. A high quality flake or pellet is a good staple, though offer your angel supplemental feedings of meaty foods such as brine shrimp, black or tubifex worms, daphnia, mysis shrimp, freeze dried krill etc to keep them in top health. Live foods can sometimes bring disease into aquariums, so buying meaty items frozen and thawing before feeding is recommended. If you buy freeze dried foods, soak them in aquarium water first to prevent bloat and other digestion problems. Occasional cooked skinned peas or veggie flakes will also be relished and aid digestion.

Tank mates

The angelfish is regarded as a good community fish, and this can certainly be the case, leading it to be

Bristlenose catfish make ideal tankmates. See Issue #12 (June, 2012) of Redfish Magazine for a care guide.

As long as they aren't tiny, many community species (such as this Swordtail or Gold Barb) are reasonable tankmates for angels. It is best to avoid nippy species (such as Serpae Tetras or Tiger Barbs) as Angelfish are slow-moving animals with long fins.

the star of your community aquarium. However, as noted earlier, these fish are cichlids and as such, can be aggressive and unpredictable. There are many stories of bully angels fighting amongst each other, with tank mates or even taking over and destroying all other life in their aquariums. Despite these horror stories, upon closer inspection it us usually clear how the aquarium set up and stocking choices lead to a poor outcome. With proper consideration for an angels temperament and preferred environment, a successful community can usually be achieved.

When starting your angelfish community tank, firstly ensure that it is full of cover, heavily planted with live or silk plants (plastic can injure fish). This is to create refuges for fish to hide in, territories to claim, and to break up lines of sight to other fish in the tank. Secondly, understock. Understocking is an excellent way to provide more space for your species to roam, claim, or hide in without treading on the turf of others. Even just stocking to the tanks comfortable limit can spark aggression as 'just enough' room is sometimes not enough when it comes to a problem fish or a territory dispute where several species might be bullied or displaced and need to find a new unclaimed area. Third, choose your tank mates wisely and add them first. Good tank mates for an angel tank are those who are peaceful and too large to be considered food. Many catfishes including plecos, larger corydoras, and ottos should do well. Peaceful shoaling fish which are not bite sized such as rainbow fish, larger tetras (excluding serpae, emperor and the 'nippy' varieties), and peaceful barbs such as cherry barbs, checker barbs or rosy barbs should also do well. Danios, pencilfish and hatchet fish can also work. Now note that as with any shoal, a group of 6 individuals is essential to provide security and create their own social hierarchy, which will prevent them nipping at the long and slow fins of the angel, so make sure there is ample room for a shoal of your desired species with space to spare for the others and the final angel stock. Larger livebearers can also coexist peacefully, although this is usually limited to platys and swordtails as guppies are savoured as food, and mollies will not tolerate the soft water required for angelfish. Other small South American cichlids may also do well given enough space. Apistogrammas or Rams are a good bet here, though some have also had success with Kribensis. The later can also be very territorial at spawning so I would avoid these or try them at your own risk. While angelfish enjoy the same water preference as discus, I would also avoid this combination as they inhabit the same mid-water areas, and angels are likely to bully them away from territories and food. Gouramis are another gamble, though more peaceful Moonlight or Pearl Gouramis may co-exist under the right conditions in a large tank.

Finally, add your angelfish last. By adding these fish last the others will have established their own territories, and there is less likely a chance that the angel will claim a spot and terrorise the other inhabitants, considering them invaders. It is also critical to consider the tanks stocking and how many angels you want to keep. The rule with angels is to keep either one, a mated pair, or a shoal of 6 or more. A single angel will usually behave well by itself, and the same can be said of a mated pair. A shoal of 6 or more will allow for social hierarchies to form, and the constant enforcement of pecking order usually prevents one angel from bullying or dominating the rest. A group of 3-4 however is often a problem. Bullying can easily happen within a small group, and should two pair off and claim a spawning site, they will naturally aggressively harass the others should they come near. By following these guidelines and ensuring a healthy stock and aquascape to suit your tank size, your community should be a success... though watch out in case you get a bully!

Breeding

Angelfish are relatively easy to spawn, and if you have a mated pair in your home aquarium this can be entertaining to watch. However, some attention is required should the breeding pair start to become overly aggressive towards the rest of the tank. To actively breed angels, start with a large group of at least 6 fish in a 55g/200L tank or larger and wait for fish to pair off. Occasionally females can pair off, so to ensure a male and female pair, sexing is recommended. Sexing can be difficult, but achievable if the genital pores are well expressed prior to mating. Females have a shorter and wider pore (ovipositor) than the male, who has a narrow tube for expelling sperm. Failing this, adult males can be recognised by observing a bulge or 'nucal hump' above the eyes on the forehead, and females having a concave area behind the pelvic fins. Females are also usually a bit plumper than males. Even after all this, sexing can still be unreliable and the only way to be confident is to see the fertilized eggs.

Once a confident male and female pair is identified, separating pairs is recommended to avoid aggres-

An Angel guards a patch of eggs laid on an artificial plant. Photo by Budi Lukman.

sion between these and other remaining fish. A 20gal/80L breeder tank will suffice for this. Conditioning with live or thawed frozen meaty foods for a week before breeding is recommended, as is raising the temperature to the low 30sC or high 80sF and performing frequent water changes. Combined, these efforts are likely to bring on spawning. Angelfish lay their eggs on vertical or near-vertical surfaces, and while they will lay eggs on aquarium glass, tubing, filter intakes, heaters etc, providing surfaces such as a large leaved plants (for example, Amazon swords in a pot, a piece of slate or terracotta pot) will make for a better and more natural surface with the advantage that the whole egg mass can be removed to a fry tank.

A fry tank can be considerably smaller, though 10gal/40L is the minimal advised for stable water chemistry. Use a heater, and a sponge filter for gentle filtration to protect tiny fry and provide circulation around eggs. The addition of methylene blue before hatching can prevent fungus growing on eggs. Once hatched, the addition of java moss or a floating plant such as hornwort (*Ceratophyllum submersum*) will offer a natural refuge to fry as well as a source of infusoria for food. Rapidly growing plants such as hornwort are also excellent as absorbing waste from the water, which is very useful to maintain water quality given the frequent feeding that fry require. Daily water changes and monitoring of the water quality is vital to raising good quantities of fry, as is proper nutrition. Infusoria and liquid fry foods are good starter foods, with fry moving on to newly hatched brine shrimp naupli and rotifers, then to ground up high quality flakes or pellets, micro worms and then to larger foods. Fry that show aggression to others can be a source of loss, and others may possess deformities, so keep an eye on fry and separate/cull as necessary.

In closing, the common though beautiful angelfish is a corner stone of the hobby for obvious reason. Its hardy and personable nature, combined with its slow movements and graceful shape, make it a perennially elegant and easy choice for hobbyists from beginner to advanced. Though occasionally unpredictable, understanding the nature of these fish can allow for some common sense choices regarding tank setup, aquascape and stocking, which should result in a tank which is not only a success, but a naturally beautiful addition to the home of any aquarist.

The School Biotope Aquarium

a guide for educators & students

by Dave Wilson
www.aquagreen.com.au

Planted aquariums are a great learning tool: demonstrating natural processes that drive life on earth. Providing the necessary conditions, food and fertilisers will provide students with an idea of how delicate aquatic systems can be, as well as instill a sense of responsibility in completing the chores on a maintenance schedule that are necessary to maintain an aquarium at its best.

The challenge with an aquarium in a public place with many masters is to develop communication between the users to a level that the aquarium appears to have only one operator. This requires a team effort and is another useful aspect in the use of the aquarium as an education tool.

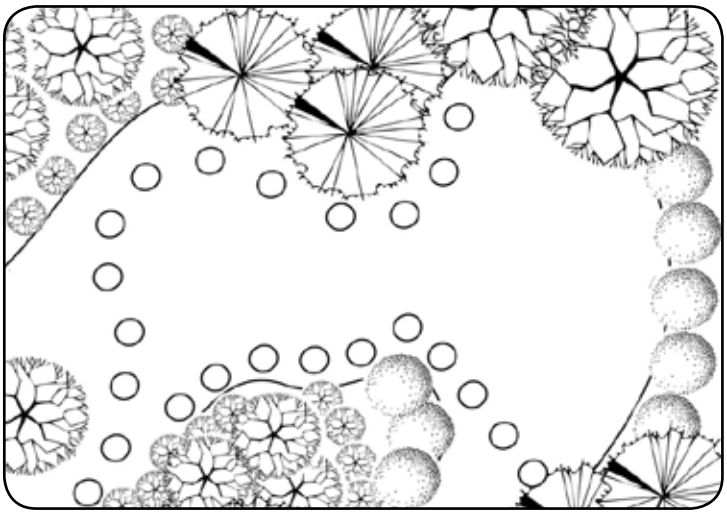
As an educational resource an aquarium can also be used to demonstrate many aspects of our natural world. For example, observing the physical manifestation of photosynthesis - when oxygen bubbles form on living, submerged aquatic plant surfaces after the application of a light source. Furthermore, studying the chemistry of water can also give the operator an appreciation of what is required to maintain the natural behaviour of life forms in an aquarium. Chemistry and mathematics can also be demonstrated when performing maintenance procedures.

Below I describe how to set up a biotope aquarium as an educational device that can support a variety of aquatic life found in a particular area. The area selected for the setup described below is in the vicinity of the Mary River at the Southern end of Kakadu National Park, but you can choose an area local to your school! At the region we are using as the model for our biotope aquarium, the traditional owners are represented by the Werenbun Association and assisted by the Jaywon Association.

This aquarium was set up with plants from only one location. All the plants in this aquarium were from the Howard River, Northern Territory (NT) Australia. The Aquarium was an entry in the Royal Queensland Show, the Ekka, and it took second prize in the Australian Native Aquarium competition.

The Aquarium pictured above was used at the Fred's Pass Show by the Australian Department of Primary Industries (DPI) to demonstrate the beauty of native Australian native aquatic plants. It uses plants sourced from various locations around Darwin, Australia.

You'll need to check local bylaws regarding collection of animals and plants, but as an educational activity - a field trip to the site you're modelling is well worth the effort.



Think of aquarium planning like you would about landscaping your garden. Draw up a plan, work out which part of the environment you'd like to model in your biotope aquarium. There are lots of creative ways to recreate the natural environment - when using artificial materials though, just be sure they don't affect the water chemistry in the aquarium - which could impact the health of your animals and plants.

required materials

- Aquarium (glass or perspex)
- Aquarium stand or cabinet
- Filter (many options)
- Heater
- Substrate
- Plants and animals

Make a plan first. Draw some sketches and make some notes about the area where the fish and plants come from (such as water quality parameters, habitat and local environment). Discuss the location with your students - what environment are you trying to recreate? If possible, take a trip to the location and conduct a survey of the plants and small fishes that will be part of the finished display aquarium.

Next is deciding on where to place the aquarium. You will need to consider access for servicing, amount of natural sunlight received and the presence of hot or cold drafts. Avoiding windows is a good idea, as natural light can be a little unpredictable and can result in algal blooms or overheating.

plants and their care

Plants require light of sufficient intensity to make photosynthesis occur. The light also needs to be on long enough for the plants to produce enough sugars for growth.
A timer can be used to manage the lighting period. A timer can be set to 10 or twelve hours, with lights coming on at start of school (about 9am) and turning off anywhere after 6pm. Consult your local aquarium to be sure you've got lights suitable for aquarium plants.

Aquatic plants take up nutrients through their leaves via the water and their roots in

the substrate. As they photosynthesise they give off bubbles of oxygen from their leaves turning minerals and carbon into sugars. Fish and invertebrates produce waste that is organic and fertilise the plants. As long as there is sufficient light and nutrients the plants can grow and thus remove waste products from the fishes.

In terms of material to plant into, there are a considerable number of commercial substrates available, however, mixing your own is straightforward. A good substrate has some sand, peat, soil and shell grit. One that has been used successfully at the aquatic plant nursery is one part fine shell grit, two parts peat moss, four parts river sand and eight parts local lateritic (clay) soil. This mix is put into the aquarium to a depth of 50 mm then another 25 to 50 mm of river sand is added over the top.

Submerged plant growth is a little different to normal plant growth in that plants have different mechanisms working. The most important difference is where they get their carbon. Terrestrial Plants have access to carbon dioxide but under water carbon dioxide becomes carbonic acid. One of the things depleted in an aquarium much more rapidly than a large water body is the carbon supply available for plants. It can be supplied by several different methods - most commonly via CO2 injection, your local aquarium can provide advice.

Mineral and organic fertilisers make up the twelve or thirteen elements essential for plant growth. They are divided into macro nutrients, that plants need larger amounts to survive and micro nutrients, minerals that plants need much smaller amounts to survive. There are many commerical fertilisers that work well in the aquarium, again its best to seek some specialist advice via your local aquarium or pond specialist. Excessively dosing with fertilisers will cause algal blooms and can be harmful to fish - so some research is warranted before adding these to your aquarium.

Northern Territory plants

Vallisneria (*Vallisneria nana*), Pogo (*Pogostemon stellatus*), Willow Hygro (*Hygrophila angustifolia*), Native Ambulia (*Limnophila brownii or L.australis*), Native Rotala (*Rotala mexicana*), Staurogyne (*Staurogyne leptocaulis*). Nardoo (*Marsilea angustifolia*) A large *Ottelia alismoides* or *Aponogeton* as a feature plant will also add to the aesthetic nature of the aquarium. If you're after floating plants, try Giant Duckweed (*Spirodela polyrhyza*).

Pogostemon stellatus in an aquarium.

Giant Duckweed (*Spirodela polyrhyza*)

Recipe: Pea and Prawn Puree

Ingredients - 30% raw prawn, 30% fish fillet, 40% peas, zucchini, carrot, and corn kernels, combined with 10 grams of calcium ascorbate per kg mince. Freeze all ingredients in chunks that will fit in mincer throat. Put frozen ingredients through hand mincer (2 or 3 mm plate) and make into a thick slurry. Mix 10 grams of calcium ascorbate (non acidic vitamin C) through mix. Place mix in plastic bags. Flatten mince till it is about one centimeter thick. Place plastic bags in freezer. When food is needed break portions from frozen slab. Feed sparingly as it will pollute the water much more readily than flake foods.

Spotted Blue-eye, *Pseudomugil gertrudae* - suitable for the community aquarium.

Delicate Blue-eye, *Pseudomugil tenellus* - suitable for the community aquarium

Species are selected to obtain a community of fish, crustaceans and invertebrates that get along together. The fish from the Mary River are (shown bottom-left and overleaf) used because of their peaceful nature and non predatory habits. Some fish are small and vegetarian but aggressively defend a patch of space by chasing all the other fish away. Some fish are just too large and require either their own aquarium or an aquarium that is too big to be practical.

The small fishes in the aquarium are termed forage fishes and are omnivores taking small aquatic and terrestrial invertebrates and some algae in their diet. The smaller shrimps are algae eaters mainly but will also clean up any left overs from the small fishes. The snails will help with this as well. These small scavengers are part of the small ecosystem and are the clean up crew. Be careful not to overstock the aquarium - essentially the more fish you house the greater the maintenance.

The fish can be fed a daily mix of crushed aquaculture pellets, or a prepared fish diet from your local aquarium but will do better with a weekly or twice weekly feeding of live foods such as Moina, Daphnia, mosquito larvae or some other small invertebrate. A homemade alternative is given top-left.

A 20-25% water change is conducted each week. Water changes are necessary to slow the accumulation of waste in the water and to replace some of the minerals depleted by the aquatic plants. Never replace all the water as you will disrupt the beneficial bacteria colonies that have grown and are essential for a healthy aquarium.

Dave Wilson

In 1995 Dave and Robyn Wilson started a small business called Aquagreen. The aim was to produce a few plants for a local Darwin aquarium shop. Aquagreen is a small licensed Aquaculture facility located at Howard Springs in the Northern Territory producing common and native plants and fishes for the aquarium Industry. Dave is an expert in Australian native fishes and plants and was Manager of the Territory Wildlife Aquarium Park, the largest freshwater public aquarium in Australia, from 1992-2001.

Penny Fish, *Denarusia bandata*

Banded Rainbowfish, *Melanotaenia trifasciata*

Exquisite Rainbowfish, *Melanotaenia exquisita*

Exquisite Rainbowfish, *Melanotaenia exquisita*

Sailfin Glassfish, *Ambassis agrammis*

Chequered Rainbowfish, *Mel. splendida inornata*

Flyspeck Hardyhead, *Craterocephelus stercusmuscarem*

Here's a selection of fishes from the Mary River region of the Northern Territory, Australia - ideal for creating the biotope aquarium discussed. Other fishes do occur in the region but many are predatory and don't make great aquarium residents.

Photos by Dave Wilson.

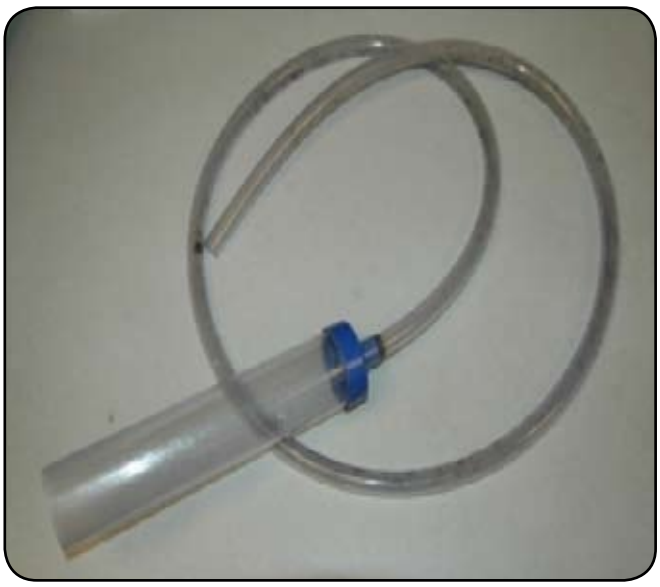
Essington Snail, *Notopala essingtonensis*

Darwin Algae eating shrimp - *Caridina* sp.

Handschin's River Prawn *Macrobrachium handschini* - The smallest and a harmless river prawn

The keeping of an aquarium in a public area where there is more than one person performing management tasks requires the need for a good communication system to be in put in place. This will allow the operators to know all that has been done to the aquarium.

Overleaf we've prepared a printable guide for the weekly maintenance of the aquarium. An aquarium is a wonderful way to explore biological, chemical and geological sciences. All the best with your aquarium!



a gravel cleaner is a useful piece of maintenance kit and will assist in removing detritus from the upper layers of the sand. Be sure not to clean too deeply where soil and laterite substrates are used.

As obvious as it might sound a few 20 litre (5 gallon) buckets with lids are a worthy investment - they are useful for transport and water changes.

Classroom Aquarium

Aquarists:
Date:

Feeding

WASH HANDS

MONDAY	☐
TUESDAY	☐
WEDNESDAY	☐
THURSDAY	☐
FRIDAY (AM)	☐
FRIDAY (PM)	☐

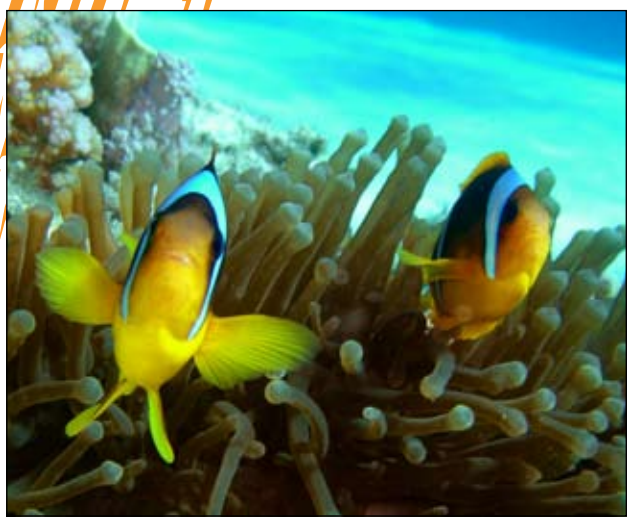
Maintenance

PH ☐ TEMP ☐

1. POWER TURNED OFF	☐
2. REMOVE LIDS	☐
3. REMOVE 10% WATER	☐
4. ADD DECHLORINATOR	☐
5. TOP UP AQUARIUM	☐
6. LIDS ON, POWER ON	☐

Observations

Red Sea Clownfish



Amphiprion bicinctus near Dahab, Egypt.
Photos by Tim Sheerman-Chase

Name: *Amphiprion bicinctus*

Common name: Red Sea Clownfish, Two-Band Clownfish

Family: Pomacentridae

Maximum size: 14cm (5.5")

Origin: Chagos Archipelago, Gulf of Aden, Red Sea and Western Indian Ocean. Typically in reef habitats in these locations, almost always with an anemone host.

Wild Host Anemones: *Entacmaea quadricolor*, *Heteractis aurora*, *Heteractis crispa*, *Heteractis magnifica* and *Stichodactyla gigantea*

Similar species: *A. bicinctus* has a distinctly yellow tail which differs from other clownfish. *A. latifasciatus* is similar, though it has a forked tail. Both *A. allardi* and *A. chagosensis* are also similar but have white tails.

Aquarium care: The species is straightforward to keep. Like most clownfish it is best kept in pairs. Anemones are not necessary, particularly for captive bred specimens. Wild-caught individuals are frequently shy in the absence of an anemone. On occassion, clownfish will choose captive corals as a host. The species is an unfussy feeder. It can be territorial, and should not be kept with other clownfish species.

Captive Breeding: Like many clownfish, *A. bicinctus* has been successfully bred in captivity. Females lay their adhesive eggs on cleaned surfaces (rocks, pots etc). Eggs hatch ~9-10 post spawning and 3-4 days post hatch larvae can be fed with rotifers. Subsequently, 5-6 day old larvae will also accept Artemia nauplii. From day 20 they will accept larger brine shrimp larvae.

First Time at Sea
a reefkeeping journal

Ok, I'm at month 3. I think its worth warning new reefkeepers about the algae bloom, it was longer and more intense than I'd imagined -- especially in a tank where you're not adding any food. There's obviously very significant amounts of cycling occuring just from the live rock as it fuels quite a spectacular bloom of algae of various kinds (I covered most of it last month!). What is clear is that 12 weeks in, it notably subsides. I suspect this is just a matter of running out of fuel - primarily phosphorus and nitrogen. With the bloom passing I've been adding a few easy to keep (apparently!) soft corals with a view to "testing the waters" and getting a bit of confidence before I move on to more difficult species. Before I get onto the corals I've added, I wanted to back track a little bit to discuss protein skimming as I've mentioned it before - without any real explanation of how it actually works.

In essence protein skimming is cheating! You're removing waste (normally nitrogen containing waste) before it has a chance to break down and enter the normal nitrogen cycle within the aquarium. Protein skimmers therefore work to lighten the bioload - that is you can keep more stock if you have one - than if you don't! This is certainly true in immature aquariums - though I suspect that dogma might break down in more mature aquariums with sufficient denitrifying capacity.

the zoanthid hitchhikers are thriving and multiplying rapidly. I know they are only brown - but I still think they are rather lovely.

The way the process works relies on an innate property of proteins. Proteins are long strings of amino acids that fold up into balls or chains. Many proteins

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- Has a flexible duckbill outlet to return water back to the aquarium

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AquaReef 400	400L	132 L x 52 D x 73/88 cm H
AquaReef 275	275L	70 L x 70 D x 77/79 cm H

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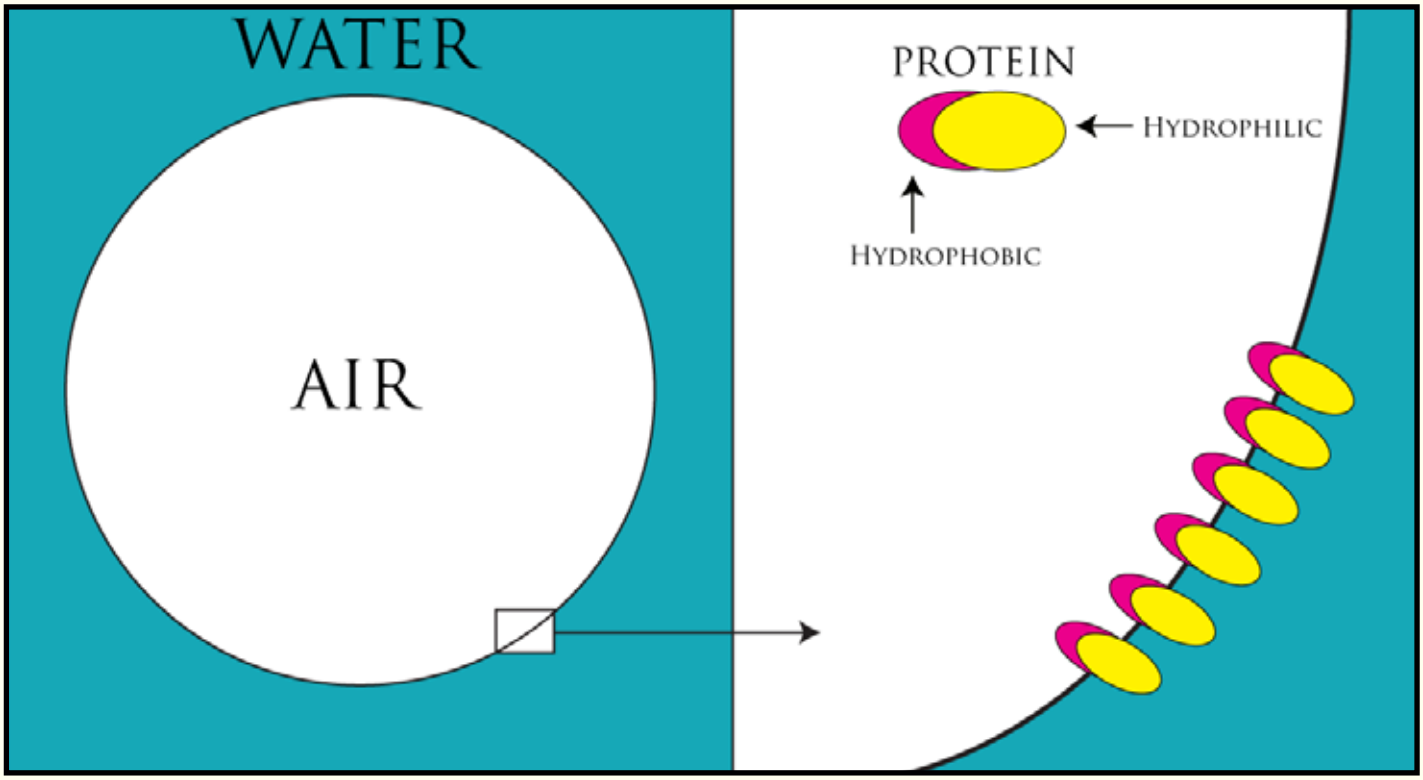
contain areas that are hydrophobic and areas that are hydrophilic (that is water hating and water loving, respectively). I know this sounds a bit odd but this property of proteins is what allows them to span biological structures like the cell membrane. You can think of the inside of the cell membrane as a kind of fatty/oily place and the outside (and inside) of the cell as place with water. Proteins that span this membrane orient themselves using this chemistry - such that the hydrophobic bits of the protein are inside the cell membrane and that the hydrophilic bits of the protein are outside the cell membrane. Structurally, air bubbles are kind of similar and its

The live rock is still throwing up surprises. I'm not sure what this is - but it motile, though not amazingly so. It's relocated itself a few times and seems happy enough pawing at the water column. For the keen eyed observer there's also a Spaghetti worm tentacle in the image.



This cartoon illustrates the skimming process for a stylised protein. Essentially the tiny bubbles created by a skimmer trap proteins which are attracted to their dual hydrophilic and hydrophobic surfaces. The resultant foam allows proteins to be removed prior to their degradation in the aquarium - thus reducing the effective bioload.

The tank as it looks today. The remnants of the massive hair algae bloom are still visible on the back glass and in patches of the sump - where the various clean-up crew have eaten away at it. The return pipe has developed a hairy red-algae coat (centre) - but its not Cyanobacteria so I'm not overly concerned. The tank is host to a pair of Common Clownfish (blurry) along with a number of soft corals.

this similarity that the skimmer uses to trap proteins onto tiny bubbles, which we remove as skimmate. It is a pretty neat trick and it works well to keep down the worst of nutrients. I can only imagine how bad the algal bloom would have been in the absence of the skimmer.

To date, I've added 7 different soft corals to the aquarium. The first coral I added was a pulsing Xenia (shown centre and right). The acquisition of this coral was a bit of a surprise, it was given to me by my local fish store (Reef River Reptile in Hornsby). The owner told me - and this was bourne out by my google searches - that wildcaught Xenia's were a bit hit-and-miss, but captive bred (fragged) specimens were remarkably hardy... and moreover this specimen was a frag of an organism that had been fragged

a pulsing Xenia in my aquarium. I've placed it in a position relatiely high up in the aquarium - where it gets a lot of water movement. It does pulse if you watch carefully and small 'pups' are growing rapidly from the base of the two larger individuals.

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many, many times. I've already noticed this organism growing - so my experiences thus far have been positive. It's an entrancing organism to watch as it waves in the current.

Along with my Xenia, I have added some red and green corallimorphs. They are called Mushrooms in the trade and you can see why - but to avoid confusion with the other mushroom corals (Fungiidae) I'll stick to "corallimorph" in these journal pieces. These organisms are phylogenetically a bit unusual and distinct from many other "coral" species - though many people consider them soft corals. In functional terms this is pretty true - they lack a carbinaceous skeleton and require similar care to other soft corals, but in biology are a bit more anemone-like than other soft corals. They can "move" extremely slowly, a process that tears the base of the organism and allows them to asexually reproduce via a process called "pedal lacteration".

I've also added a few leathers of different kinds - I'm certainly no expert on their identity and would love to hear from you if you can ID these

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When he's not editing Redfish Magazine, David Midgley is a scientist who has a PhD in Microbial Ecology and works with microbes in the subsurface. He lives in Sydney, Australia with his wife, kids, cats and now - Reef Aquarium.

Crimson and green corallimorphs. The textures of these animals are almost as fascinating as their colours.

This is a green polyped Sarcophyton (I think!). At night its polyps retract and the macro structure closes a little, presumably to afford some protection at night.

Two other leather corals in my aquarium. Both close their polyps at night and retract their bodies into more dense forms. Around the leathers, the live rock is host to many single zoanthids, one brown type with a green centre is shown left.

animals. The common name Leather Coral covers a handfull of genera most commonly Lobophytum, Alcyonium, Cladiella, Sarcophyton and Sinularia. At night they've an unreal, plastic appearance but arent particularly leathery (at least in my opinion).

The plan from here is to continue to slowly add corals working towards a display aquarium. I'm not anywhere near this point yet and I'm learning something new each month. With regard to fish I'm planning on adding a few gobies and blennies species - but not much else, I'd like to the keep the aquarium primarily for corals. I'm also in the process of trying to find a local club - a great support tool for the marine hobbyist and will post details of my successes and failures. If you'd like to comment, correct or ID any of my photos - I'd love to here from you - drop me an email at: david@redfishmagazine.com.au. See you in August!

photo by Khantipol

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CANADA

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Alberta

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Edmonton Aquarium Club	http://www.fish-club.org/

British Columbia

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Wet Coast Aquarium Society	http://wetcoastaquariumsociety.ca/wetcoast/

Ontario

Brampton Aquarium Club	http://www.bac-on.org/
Peel Aquarium Club	http://www.peelaquariumclub.org/
Brant Aquarium Society	http://www.brantaquariumsociety.ca/
Chatham-Kent Aquarium Society	http://www.cichlidae.com/forum/viewforum.php?f=103
St Catharines & Area Aquarium Soc.	http://www.scaas.info/index.html
Durham Region Aquarium Society	http://www.dras.ca/
Ottawa Valley Aquarium Society	http://ovas.ca/
Hamilton & District Aquarium Society	http://www3.sympatico.ca/ps.mcfarlane/home.htm
Forest City Pond Club	http://www.freewebs.com/fcpc/
Kitchener/Waterloo Aquarium Society	http://www.kwas.ca/
London Aquarium Society	http://www.londonaquariasociety.com/
Sarnia Aquarium Society	http://www.geocities.com/sarniaaquariumsociety/
Toronto Willowdale Aquarium Society	http://www.torontoaquarium.org/

Manitoba

Aquarium Society of Winnipeg	http://www.asw.ca/

Nova Scotia

East Coast Aquarium Society	http://www.eastcoastaquariumsociety.ca/forum/

Saskatchewan

Saskatoon Aquarium Society	http://www.saskatoonaquarium.com/
Regina Aquarium Society	http://www.reginaaquariumsociety.ca/

Quebec

Montreal Aquarium Society	http://www.geocities.com/mtlfishclub/index.html
La Societe des Aquariophilie de Montreal	http://www.aquasam.qc.ca/
Ass. Reg. des Aquariophiles de Quebec	http://www.oricom.ca/pierdes/

UNITED STATES OF AMERICA

Alaska

Juneau Aquarium Society	http://www.taursys.com/kasha/JAS/

Arizona

Dry Wash Aquarium Society	http://www.drywashaquarium.org/

California

Bakersfield Koi & Water garden Society	http://www.bakersfieldkoiclub.com/
Desert Fish Club	http://www.desertfishclub.com
Sacramento Aquarium Society	http://www.sacramentoaquariumsociety.org/
San Francisco Aquarium Society	http://www.sfaquarium.org/
Silicon Valley Aquarium Society	http://www.tactics.com/d/svas/
Santa Clara Valley Koi and Water Garden Club	http://www.sckoi.com/
San Diego Tropical Fish Society	http://www.geocities.com/sandiegofishfan/
Pacific Coast Cichlid Association	http://www.cichlidworld.com/

Colorado

Southern Colorado Aquarium Society	http://www.southerncoloradoaquariumsociety.com/
Colorado Aquarium Society	http://www.coloradoaquarium.org
Rocky Mountain Cichlid Association	http://www.liss.olm.net/rmca/

Connecticut

Aqua-Land Aquatic Society	http://pages.cthome.net/vito/
Exotic Fish Society of Hartford Inc.	http://users.rcn.com/wmercer/
Norwalk Aquarium Society	http://www.castaways56.supanet.com/

Florida

Gold Coast Aquarium Society South Florida	http://www.gcassf.org/Home.htm
Tampa Bay Aquarium Society	http://www.tbas1.com/

Georgia

Atlanta Area Aquarium Society	http://atlantaaquarium.com/

Hawaii

Honolulu Aquarium Society	http://www.geocities.com/Heartland/Meadows/2948/HASF.html

Illinois

Champaign Area Fish Exchange	http://www.champaignfish.com/
Chicagoland Marine Aquarium Society	http://www.cmas.net/
Planted Aquarium Club of Chicago	http://www.pacchicago.org/
Tri-County Tropical Fish Society	http://aquariumhobbyist.com/tctfs/index.html
Greater Chicago Cichlid Association	http://www.gcca.net
Rockford Reefers Aquarium Club	http://www.rockfordreefersaquariumclub.org/

Indiana

Circle City Aquarium Club, Inc.	http://www.circlecityaqclub.org
Indiana Marine Aquarium Society	http://indmas.org
Michiana Aquarium Society	http://michianaaquariumsociety.org/

Iowa

Eastern Iowa Aquarium Association	http://www.eiaainfo.org/
Iowa Aquarium Society	http://www.iowaaquaria.com/
Greater Iowa Reef Society	http://www.greateriowareefsociety.org/

Kentucky

Greater Louisville Koi & Goldfish Society	http://www.louisvillekoiclub.com/
Louisville Marine Aquarium Society	http://www.lmas.org/joomla/

Maine

Great Lakes Aquarium Society	http://www.glaquarium.org/
Wochester Aquarium Society	http://www.petsforum.com/was/

Massachusetts

Boston Aquarium Society	http://www.bostonaquariumsociety.org/
Pioneer Valley Aquarium Society	http://www.pvas.net/html/
Worcester Aquarium Society	http://www.petsforum.com/was/

Michigan

The Aquarium Society of Ann Arbor	http://sitemaker.umich.edu/aquarium.society
Grand Valley Aquarium Club	http://www.grandvalleyaquariumclub.org
Southwestern Michigan Aquarium Society	http://www.swmas.org/
Motor City Aquarium Society	http://home.att.net/%7ec.r.newell/clubs/page2.html
Greater Detroit Aquarium Society	http://www.greaterdetroitaquariumsociety.com/
Metro Detroit Aquarium Clubs	http://home.att.net/~c.r.newell/clubs/
Upp. Peninsula of Michigan Marine Aq. Soc.	http://www.upmmas.com/
Marinelife Aquarium Society of Michigan	http://www.masm.org/

Minnesota

Minnesota Aquarium Society	http://www.mn-aquarium.org/
Red River Valley Aquarium Club	http://www.geocities.com/fmaquarium/

Missouri

Missouri Aquarium Society	http://www.MissouriAquariumSociety.com
Heart of America Aquarium Society	http://www.kcfishclub.org/

New Hampshire

New Hampshire Aquarium Society	http://www.nhaquariumsociety.com/index.htm

New Jersey

Jersey Shore Aquarium Society	http://www.jerseyshoreas.org/
North Jersey Aquarium Society	http://www.njas.net/

New York

Greater City Aquarium Society	http://ourworld.compuserve.com/homepages/greatercity/
Brooklyn Aquarium Society	http://www.basny.org/
Allegheny River Valley Aquarium Society	http://www.orgsites.com/ny/arvas
Long Island Aquarium Society	http://www.liasonline.org
Central New York Aquarium Society	http://www.cnyas.org/
Nassau County Aquarium Society	http://www.ncasweb.org
Danbury Area Aquarium Society	http://northeastcouncil.org/daas/index.html
Tropical Fish Club of Erie County	http://tfcec.tripod.com/tfcecwebsite/

North Carolina

Raleigh Aquarium Society	http://www.fishclubs.com/nc/ras/main.html
Cape Fear Aquarium Society	http://capefearaquariumsociety.com/

Ohio

Stark County Aqua Life Enthusiasts	http://www.scalesclub.com/
Greater Cincinnati Aquarium Society	http://www.gcas.org/
Cleveland Aquarium Society	http://www.clevelandaquariumsociety.org
Ohio Cichlid Association	http://www.ohiocichlid.com/
Greater Akron Aquarium Society	http://www.gaas-fish.net
Medina County Aquarium Society	http://www.geocities.com/MCASfish/
Youngstown Area Tropical Fish Society	http://www.yatfs.com/
Ashtabula County Aquarium Club	http://www.geocities.com/Heartland/Park/6982/index.html
Lorain County Aquarium Society	http://geocities.com/RainForest/Andes/3049/
Columbus Area Fish Enthusiasts	http://www.columbusfishclub.org/

Oklahoma

Oklahoma Aquarium Association	http://petsforum.com/okcaa/

Oregon

Greater Portland Aquarium Society	http://www.gpas.org/

Pennsylvania

Bucks County Aquarium Society	http://www.bcasonline.com/

Pennsylvania (cont)

Delaware County Aquarium Society	http://www.dcas.us
International Betta Congress	http://ibcbettas.com/
Aquarium Club of Lancaster County	http://www.aclc.us/
Northeast Philadelphia Aquarium Society	http://www.phillyfishclub.com/
Greater Pittsburgh Aquarium Society, Inc.	http://www.gpasi.org
Pittsburgh Marine Aquarium Society	http://www.pmasi.org/frm/
Erie Aquarium Society	http://groups.yahoo.com/group/ErieAquariumSociety/

Rhode Island

Tropical Fish Society of Rhode Island	http://www.tfsri.org/

South Carolina

Myrtle Beach Aquarium Club	http://www.facebook.com/pages/Myrtle-Beach-Aquarium-Club/402263799688

Tennessee

Putnam County Aquaiurm Society	http://www.pcaquarium.org
West Tennessee Marine & Reef Aquarium Club	http://www.wtmrac.com/

Texas

Federation of Texas Aquarium Societies	http://www.fotaswebsite.org/
Capital Aquarium Society of Texas	http://www.petsforum.com/cas/
Dallas/Ft. Worth Aquatic Plant Club	http://www.aquatic-plants.org/
North Texas Water Garden Society	http://www.ntwgs.org/

Utah

Great Salt Lake Aquarium Society	http://fancyguppy.50megs.com/custom2.html
Wasatch Marine Aquarium Society	http://www.utahreefs.com/

Vermont

Black River Aquarium Society	http://www.angelfire.com/vt/brasvt/

Virginia

Potamac Valley Aquarium Society	http://www.pvas.com/pvasindex.htm

Washington

Bellinghan Aquarium Society	http://www.facebook.com/pages/Bellingham-Aquarium-Society/112557868810416
Greater Seattle Aquarium Society	http://www.gsas.org/
Kitsap Aquarium Society	http://www.geocities.com/Petsburgh/5640/kastoc.htm
Washingon Koi and Water Garden Society	http://www.washingtonkoi.org/

Wisconsin

Milwaukee Aquarium Society	http://fishclubs.com/WI/MAS/
Green Bay Aquarium Society	http://www.gbasonline.org/gbashome.htm
Central Wisconsin Aquarium Society	http://www.cwas.org/

PUERTO RICO

Asoci. de Acuaristas de Aguadilla	http://coqui.metro.inter.edu/acuaristas/aaa.html
Acuarista Metro Este	http://www.amepr.org/

BERMUDA

Bermuda Fry-Angle Aquarium Society	http://www.fryangle.com/

BRAZIL

Aquaflux Aquarismo e Aquapaisagismo	http://www.aquaflux.com.br
Aqualinea	http://aqualinea.com.br/blog/

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